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Deep borehole stratigraphy and basin structure of the southern Karoo Basin, South Africa

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The subsurface stratigraphy and structure of the southern Karoo Basin of South Africa is described based on detailed re-logging 11 deep boreholes drilled by SOEKOR in the 1960s. The Karoo Supergroup here is between 750 and more than 5540 m thick. The sequence starts with an extensive cover of glaciomarine and/or glaciolacustrine bedded diamictites with black shales of the mid-Carboniferous to Lower Permian Dwyka Group, between 353 and 744 m thick. In the south, the basal contact is a para-unconformity within the uppermost sequence of the underlying Cape Supergroup (the Witteberg Group), whereas in the north the diamictites overly an unconformity across Precambrian basement marked with glacial pavements, paleo-valleys and eskers that indicate regional ice transport toward the south. The top of the glacial sequences is capped by 79 to 569 m carbon-rich black shales of the lowermost Ecca Group deposited during rapid deglaciation that marks a relatively short-lived time horizon, just before 288-291 Ma, based on U/Pb dates of magmatic zircons from thin tuffs near the base of the deglaciation sequence. The black shales, known as the Prince Albert and Whitehill Formations, are in turn transitionally overlain by rhythmites with chert beds (the Collingham Formation including the Matjiesfontein Chert) and thin bedded coarsening-upward turbidites, up to 634 and 681 m thick in the southernmost boreholes (Fig. 1), characteristic of prograding basin-floor fans. These and all overlying sequences were consistently derived from the south, and can be linked to basin inversion due to the emergence of the Cape Fold Belt during the Permian-Triassic (245-276 Ma). The Ecca turbidites grade over a distance of less than 50 km northward into alternating dark grey silty shales with fine sandstones and carbonated mudstones characteristic of shallower shelf-slope deposits. Upward, the successions become regionally sandier and thicker bedded upward, implying a first-order regression, but the transition with the overlying fluvial Beaufort Group cannot be mapped with confidence because core samples and mud-log descriptions are not diagnostic of a subaerial depositional environment. In addition, the Karoo Supergroup is variably deformed and fractured along the southern margin, adjacent to the Cape Fold Belt, whilst farther north increasingly abundant dolerite sills intrude progressively to greater depths (maximum 3.7 km), all of which complicate unravelling the subsurface basin stratigraphy.

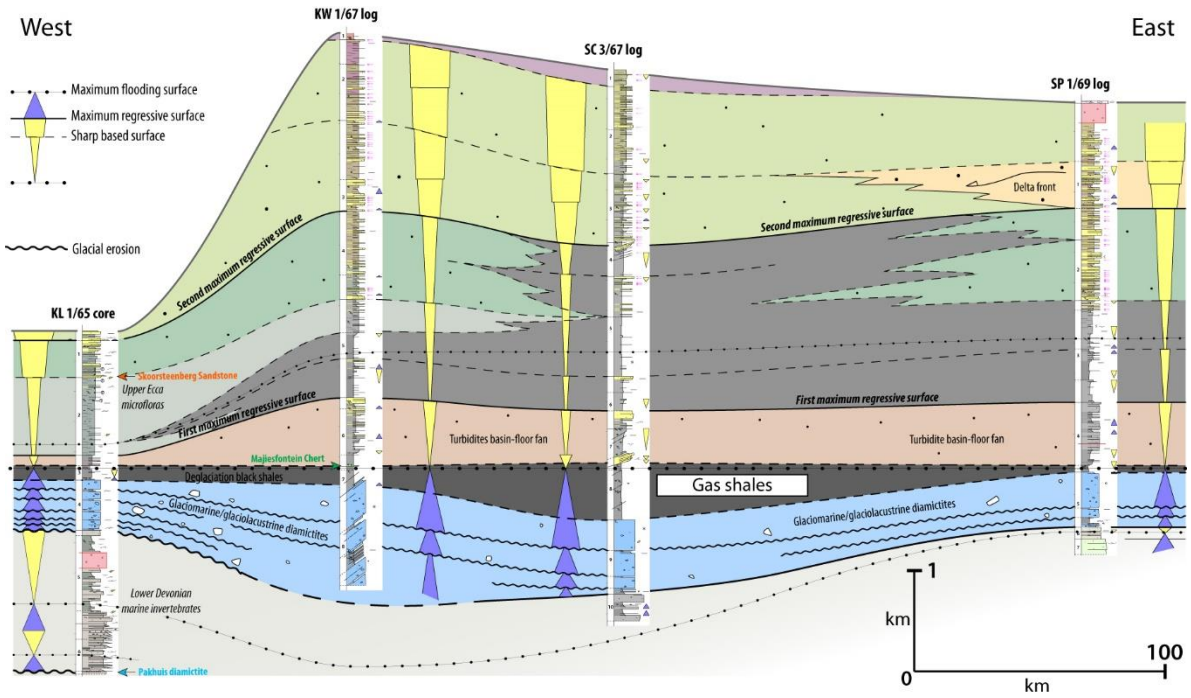


Figure 1: East-West sequence correlation profile, 850 km long across the southern Karoo Basin

